FINAL - ET 55 - Electrician Theory Examination Marking Schedule

Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. This schedule sets out the accepted answers to the examination questions. A marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. Symbols and terms - alternatives

Power	W or P
Voltage	V or E or U
Phase	Active

Question 1	*Reference Marks*	*Marking notes*
(a) (i) 1MΩ (ii) 0.01MΩ	(1 mark) (1 mark)	
(b) (i) Any ONE of: ● The power factor of the motor will be poor ● The motor will be less efficient. ● Running costs rise (ii) Any ONE of: ● The motor ventilation is restricted in some manner. ● The cooling fan has become detached from the motor shaft	(1 mark) (1 mark)	
(c) (i) Clamped around the protective earthing conductor (ii) 5 mA	(1 mark) (1 mark)	
(d) ● As the current through the protective device increases. ● The time taken to operate decreases.	(1 mark) (1 mark)	
(e) Any TWO of: ● Capacitors ● Inductors ● Resistors	(2 marks)	
(f) An auto transformer can fail in such a way so the primary voltage appears across the	(2 marks)	

Question 1	*Reference Marks*	*Marking notes*
secondary		
(g) V = $\sqrt{(P \times R)}$	(½ mark)	
= $\sqrt{(2204 \times 24)}$	(½ mark)	
= 230V	(1 mark)	
(h) The internal circuitry of the electrical equipment would be live when the isolating switch is in the OFF position.	(2 marks)	
(i) (i) pf = $\frac{P}{\sqrt{3} \times V_L \times I_L}$	(1 mark)	
(ii) R = $\frac{V^2}{P}$	(1 mark)	
(j) (i) A bi-polar junction transistor	(1 mark)	
(ii) A device that changes energy from one form to another	(1 mark)	

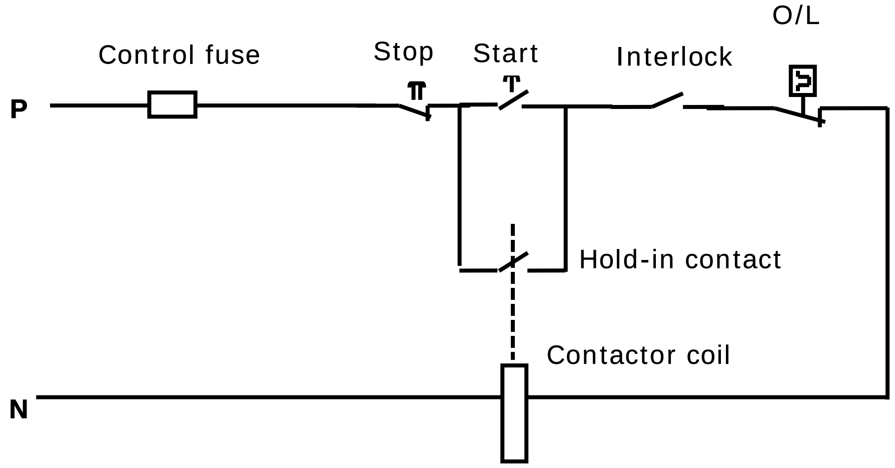
Question 2	*Marks*	*Reference*	*Marking notes*
(a) The description has to include:			
● Disconnecting the cables at the motor	(1 mark)		
● Separating the windings of the motor	(1 mark)		
● Use of an insulation resistance tester.	(½ mark)		
● Applying a test voltage of 500V d.c.	(½ mark)		
● Testing the cable Testing between each phase conductor.	(½ mark)		
Testing between each phase conductor and the protective earthing conductor.	(½ mark)		
● Testing the motor Testing between each winding.	(½ mark)		
Testing between each winding and the frame of the motor.	(½ mark)		
● A insulation resistance test result of much less than 1 MΩ	(1 mark)		
(b) (i) The description has to include:			
● Use of an ohmmeter	(½ mark)		
● Testing between the frame of the motor and earthing point independent of the motor circuit	(1 mark)		
● A test result of 1Ω or less.	(½ mark)		
(ii) Any ONE of: ● That the protective devices will operate under earth fault conditions. ● It proves the motor is effectively earthed	(1 mark)		
(c) Any ONE of: ● Voltage test ● Load test	(1 mark)		

Question 3	*Marks*	*Reference*	*Marking notes*
(a) (i) $I_{PH} = \frac{V_{PH}}{R_{PH}}$	(½ mark)		
$= \frac{230}{30}$	(½ mark)		
$I_{PH} = 7.66A$	(½ mark)		
$I_L = I_P = 7.66A$	(½ mark)		
$P = V_L \times I_L \times \sqrt{3} \times pf$	(½ mark)		
$= 400 \times 7.66 \times \sqrt{3} \times 1$	(½ mark)		
$= 5307W$	(1 mark)		
(ii) Any ONE of: ● 1.0 mm^2 ● 1.5 mm^2	(½ mark)		
(iii) 10A	(½ mark)		
(b) (i) $I_{PH} = \frac{V_P}{R_{PH}}$			
$= \frac{400}{30}$	(½ mark)		
$= 13.33A$	(½ mark)		
$I_L = I_P \times \sqrt{3}$	(½ mark)		
$= 13.33 \times \sqrt{3}$	(½ mark)		
$= 23.1A$	(1 mark)		
$P = V_L \times I_L \times \sqrt{3} \times pf$			
$= 400 \times 23.1 \times \sqrt{3} \times 1$			
$= 16003W$	(1 mark)		
(ii) Any ONE of: ● 2.5 mm^2 ● 4.0 mm^2	(½ mark)		
(iii) 25A	(½ mark)		

Question 4	*Reference Marks*	*Marking notes*
(a) (i) A Starter unit	(½ mark)	
B Radio interference suppressor	(½ mark)	
C Glow starter	(½ mark)	
D Tube electrodes	(½ mark)	
E Fluorescent tube	(½ mark)	
F Any ONE of: ● Ballast ● Inductor ● Choke	(½ mark)	
G PF correction capacitor	(½ mark)	
H Fuse	(½ mark)	
(ii) Any ONE of: ● Prevents electromagnetic interference ● Contact arc suppression in the glow starter. ● Prevents radio frequency interference.	(1 mark)	
(iii) Any ONE of: ● Limits the level of current flowing through the electrodes and tube ● Provides a surge of potential high enough to cause the tube to strike.	(1 mark)	
(b) (i) Light is produced by an electric discharge by passing current through a gas or vapour in the discharge tube	(2 marks)	
(ii) Any TWO of: ● Mercury vapour ● Metal halide ● Sodium vapour ● Fluorescent light ● Neon light	(1 mark)	
(c) Any TWO of: ● Provides clear vision without eye strain ● Sufficient light intensity ● Minimum glare ● Uniform light intensity throughout the illuminated area ● Suitable colour rendering	(1 mark)	

Question 5	*Reference Marks*	*Marking notes*
(a) (i) There is no certainty that the fuse with operate within 4 hours at 1.5x its rated current (ii) The HRC fuse or MCB will operate with certainty within 4 hours at 1.5x its rated current	(2 marks) (2 marks)	
(b) (i) The pre-arcing time is the time taken for a fault current large enough to operate the fuse (ii) The arcing time is time taken from the initiation of the arc Until the fuse elements have opened and the arc extinguished	(2 marks) (2 marks)	
(c) Only the protective device closest to the fault operates	(2 marks)	

Question 6	*Reference Marks*	*Marking notes*
(a) (i) An MEN switchboard	(½ mark)	
(ii) ● The earth bar ● The earth electrode	(1 mark)	
(iii) A tag warning against disconnection	(½ mark)	
(b) Any SEVEN of: ● The main earth bar. ● The main earthing conductor. ● The MEN connection (link). ● The main neutral bar. ● The main neutral conductor. ● Protective earthing conductors. ● Equipotential bonding conductors.	(3½ marks)	
(c) ● The star point of the distribution transformer	(½ mark)	
● The distribution line neutral	(½ mark)	
● The consumers installation	(½ mark)	
(d) $I_F = \frac{V}{Z}$	(½ mark)	
$= \frac{230}{0.32}$	(½ mark)	
$= 718.75A$	(½ mark)	
$I_F = \frac{V}{Z}$		
$= \frac{230}{0.58}$		
$= 396.55A$	(½ mark)	
$= 718.75 - 396.55$	(½ mark)	
$= 322.2A$	(½ mark)	

Question 7	*Reference Marks*	*Marking notes*
(a) (i)  P N Control fuse Stop Start Interlock O/L Hold-in contact Contactor coil		
● Supply correctly connected	(½ mark)	
● Fuse correctly connected	(½ mark)	
● Stop button correctly connected	(½ mark)	
● Start button correctly connected	(½ mark)	
● Hold-in contacts correctly connected	(½ mark)	
● Contactor coil correctly connected	(½ mark)	
● Interlock contact correctly connected	(½ mark)	
● Overload auxiliary contact correctly connected	(½ mark)	
● Correct working circuit	(1 mark)	
(b) Any ONE of ● The motor cannot be stopped with either stop button ● Both stop buttons have to be pushed simultaneously to stop the motor	(2 marks)	
(c) The maintaining circuit is open-circuited.	(1 mark)	
(d) ● The variable speed controller varies frequency and voltage to vary the speed. ● The electronic soft start varies voltage on starting to limit starting current.	(1 mark) (1 mark)	

Question 8	*Reference Marks*	*Marking notes*
(a) $I_P = \frac{\text{Input}}{V_P}$ $= \frac{25}{230}$ $= 0.11\text{A}$	(½ mark) (½ mark) (1 mark)	
(b) $N_S = \frac{N_P \times 1}{19}$ $= \frac{2000 \times 1}{19}$ $= 105$ turns	(½ mark) (½ mark) (1 mark)	
(c) $V_S = \frac{N_S \times V_P}{N_P}$ $= \frac{105 \times 230}{2000}$ $= 12\text{V}$	(½ mark) (½ mark) (1 mark)	
(d) $I_S = \frac{\text{Input}}{V_S}$ $= \frac{25}{12}$ $= 2.08\text{A}$	(½ mark) (½ mark) (1 mark)	
(e) Volts per turn $= \frac{V}{N}$ $= \frac{230}{2000}$ $= 0.115$ volts per turn	(½ mark) (½ mark) (1 mark)	

Question 9	*Marks*	*Reference*	*Marking notes*
(a) Resistance of oven			
$R = \frac{V^2}{P}$	(½ mark)		Accept any valid alternative method
$= \frac{230 \times 230}{2000}$	(½ mark)		
= 26.45Ω	(1 mark)		
Voltage dropped across element 1			
$= \frac{6.62 \times 230}{26.45}$	(½ mark)		
= 57.57V	(½ mark)		
Power consumed by element 1			
$P = \frac{V^2}{R}$	(½ mark)		
$= \frac{57.57 \times 57.57}{6.6}$	(½ mark)		
= 500.65W	(1 mark)		
(b) (i) Voltage drop across element 2 and element 3			
= 230 – 57.57	(½ mark)		
= 172.43V	(½ mark)		
Power consumed by element 2			
$P = \frac{V^2}{R}$	(½ mark)		
$= \frac{172.43 \times 172.43}{59.4}$	(½ mark)		
= 500.54W	(½ mark)		
Power consumed by element 3			
= 2000 – (500 + 500)	(½ mark)		
= 1000W	(1 mark)		
(ii) $R = \frac{V^2}{P}$			
$= \frac{172.43 \times 172.43}{1000}$	(½ mark)		
= 29.73Ω	(1 mark)		